REMARKS

Applicants have canceled claim 8 and amended claims 1-7 and 9-22. Thus, claims 1-7 and 9-22 are pending in the application and presented for examination. Applicants respectfully request allowance of the present application in view of the foregoing amendments and the following remarks.

Response To Objections Under 37 C.F.R. 1.75(c):

Claims 10 and 12 stand objected to under 37 C.F.R. 1.75(c), the Examiner stating that the claims are in improper form because a multiple dependant claim cannot depend from another multiple dependant claim. Applicants respectfully note that claims 10 and 12, as amended in the preliminary amendment dated May 2, 2000, are in proper form. In particular, claim 10 depends from claim 9 which, in turn, depends from claim 2. Similarly, claim 12 depends from claim 10 which, in turn, depends from claims 9 and 2. Applicants respectfully request withdrawal of this objection.

Response To Rejections Under Section 112:

Claims 6-12 and 17 stand rejected under 35 U.S.C. § 112, second paragraph, the Examiner stating that the language therein is indefinite due to the phrase "additional oxides" and "several additional oxides". Applicants respectfully submit that the term "oxide" is clearly understood by those skilled in the art. An oxide is simply "a compound in which oxygen is bonded to one or more electropositive atoms". Random House Websters' Unabridged Dictionary, 2nd Edition, 1999. Applicants have amended these claims to clarify that the

additional oxide or several additional oxides are admixed to the spinel. See e.g., spec. page 11, lines 14-17.

Claims 15 and 21 stand rejected under 35 U.S.C. § 112, second paragraph, the Examiner stating that the language therein is indefinite, as filed. In response, Applicants have deleted the phrase "based".

Response To Rejections Under Section 102:

Claims 1-9, 11, and 13-21 stand rejected under 35 U.S.C. §§ 102(e) and/or 102(b), the Examiner contending that these claims are anticipated by Beele (6,127,048), Hasz, et al. (5,914,189, 5,773,141, 5,660,885), Miyata (5,629,251), Lee, et al. (5,466,280), Friese, et al. (5,310,575), Gigliotti, et al. (3,995,616), Pareek, et al. (5,520,751), Druschitz, et al. (5,037,070), Siemens (WO 96/34128), General Electric (EP 608081), or Norton (GB 745,257). The Examiner apparently reads each of these references as disclosing the claimed spinel structural formula, and believes that the expansion and conductivity is inherent to the composition.

Applicants' invention involves a thermal barrier coating material comprising a spinel of the structural formula AB_2X_4 or $B(AB)_2X_4$. Prior art thermal barrier coatings have a thermal expansion coefficient of only about 70% of the thermal expansion coefficient of the metallic substrate. This low thermal expansion coefficient (and high thermal conductivity) causes thermal stress during exposure to a hot gas which leads to sintering and other failure of the thermal barrier coating. Applicants' claimed spinel invention, in contrast, provides a relatively high thermal expansion coefficient and low thermal conductivity to inhibit sintering. See, e.g., spec. page 4 line 18 - page 5, line 17.

Applicants' respectfully traverse each of the references cited by the Examiner as follows.

Beele (6,127,048) discloses three spinel thermal barrier coatings, $YbAl_2O_4$, $MgAl_2O_4$, $CaAl_2O_4$ (col. 3, lines 48-51). Of these spinels, however, only one was originally claimed by Applicants in one claim ($MgAl_2O_4$ in claim 4). Applicants have amended claim 4 to exclude this spinel

Hasz, et al. (5,914,189) discloses one spinel thermal barrier coating, $MgAl_2O_4$ (see, e.g. col. 5, line 3). Like with Beele, this spinel was originally claimed by Applicants in only claim 4, and Applicants have amended claim 4 to exclude this spinel.

Hasz, et al. (5,773,141, 5,660,885) discloses no spinel thermal barrier coatings. Rather, Hasz discloses a CMAS sacrificial oxide coating that reacts with environmental contaminants encountered on surfaces of thermal barrier coated parts during service operation in order to increase the melting temperature or viscosity of the contaminant (col. 2, lines 40-46 and col. 3, lines 20-30).

Miyata (5,629,251) discloses one spinel thermal barrier coating, $MgAl_2O_4$ (see, e.g. col. 5, line 60). Like with Beele, claim 4 has been amended to exclude this spinel.

Hasz, et al. (5,914,189) discloses one spinel thermal barrier coating, $MgAl_2O_4$ (see, e.g. col. 5, line 3). Like with Beele, claim 4 has been amended to exclude this spinel.

Lee, et al. (5,466,280), discloses six spinel thermal barrier coatings, $MgFe_2O_4$, $FeCr_2O_4$, $FeAl_2O_4$, $MgAl_2O_4$, $MgCr_2O_4$, $FeFe_2O_4$ (col. 13, lines 6-23). Of these spinels, however, only three were originally claimed by Applicants ($FeCr_2O_4$, $FeAl_2O_4$, $FeFe_2O_4$). Applicants have amended the claims to exclude these three spinels.

Friese, et al. (5,310,575) discloses one spinel thermal barrier coating, $MgAl_2O_4$ (see, e.g. col. 2, lines 66-68). Like with Beele, claim 4 has been amended to exclude this spinel .

Gigliotti, et al. (3,995,616) discloses one spinel thermal barrier coating, $FeCr_2O_4$ (see, e.g. col. 3, lines 3-5). Like with Lee, Applicants have amended the claims to exclude this spinel.

Pareek, et al. (5,520,751) discloses two spinel thermal barrier coatings, $NiAl_2O_4$ and $NiCr_2O_4$ (see, e.g. col. 3, lines 3-5). Applicants have amended the claims to exclude these spinel.

Siemens (WO 96/34128) discloses one spinel thermal barrier coating, $ZrAl_2O_4$ (see, e.g. page 12, lines 7-10 and page 11, lines 21-24). Applicants do not claim this spinel.

General Electric (EP 608081) discloses one spinel thermal barrier coating, $MgAl_2O_4$ (see, e.g. page 2, line 14). Like with Beele, claim 4 has been amended to exclude this spinel.

Norton (GB 745,257) discloses one spinel thermal barrier coating, $MgAl_2O_4$ (see, e.g. page 3, line 50). Like with Beele, claim 4 has been amended to exclude this spinel.

In addition, the cited art does not disclose admixing one or more oxides to the spinel, and does not disclose the particular spinel compositions, as recited in the claims. Moreover, Applicants believe that many of the spinels disclosed in the cited art do not posses, inherently or otherwise, the relatively high thermal expansion coefficient and low thermal conductivity necessary to inhibit sintering that Applicants' claimed spinels possess, and that it would not have been obvious to modify these spinels to achieve these properties.

For the foregoing reasons, Applicants respectfully request that the Examiner withdraw the Section 102 rejection.

CONCLUSION

For the foregoing reasons, it is respectfully submitted that the objections and rejections set forth in the outstanding Office Action are inapplicable to the present claims and specification.

Accordingly, Applicants respectfully request that the Examiner reconsider the objections and rejections and timely pass the application to allowance.

The undersigned has made a good faith effort to respond to all of the objections and rejections in the application and to place the claims in condition for allowance. Should the Examiner have any questions concerning this paper or application, or if any undeveloped issues or questions remain, the Examiner is respectfully requested to contact Applicants' undersigned attorney to resolve such issue or question. All correspondence should continue to be directed to our below-listed address.

Please grant any extensions of time required to enter this paper. The commissioner is hereby authorized to charge any appropriate fees due in connection with this paper or credit any overpayments to Deposit Account No. 19-2179.

Respectfully submitted,

Dated: 12/7/01

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VERSION WITH MARKINGS TO SHOW CHANGES MADE
(PAGES 10 - 13)

IN THE CLAIMS:

Claims * have been amended as follows:

1. (Amended) [Product (1), particularly a gas turbine component] An article of manufacture that can be exposed to a hot [aggressive] gas [with] and including a metallic base body [(2)] having a ceramic barrier coating [(4)] bonded thereto, which has a spinel of the structural formula AB_2X_4, where

- X represents an element or several elements of the group comprising aluminum, sulfur, selenium, and tellurium,
- A represents an element or several elements of the group comprising aluminum, manganese, iron, cobalt, nickel, copper, zinc, cadmium, silicon, titanium and tungsten, and
- B represents an element or several elements of the group comprising aluminum, magnesium, manganese, iron, vanadium, chromium, gallium, silicon, titanium sodium, and potassium

excluding the spinels of the structural formula $FeCr_2O_4$, $FeAl_2O_4$, $FeFe_2O_4$, $NiAl_2O_4$ and $NiCr_2O_4$.

2. (Amended) [Product (1)] The article of manufacture as claimed in Claim 1, characterized in that B represents aluminum (aluminate spinel) or chromium (chromium spinel), A represents nickel, cobalt or titanium, and X represents oxygen.

3. (Amended) [Product (1)] The article of manufacture as claimed in Claim 1, characterized in that B magnesium, A titanium, and X oxygen.

4. (Amended) [Product (1), which is a gas turbine component and as such] An article of manufacture that can be exposed to a hot [aggressive] gas, and having a metallic base body [(2)] with a ceramic barrier coating [(4)] bonded thereto which has a spinel according to the structural formula AB_2X_4 characterized in that B represents aluminum (aluminate spinel) or chromium (chromium spinel), A represents magnesium, and X represents oxygen.

5. (Twice Amended) [Product (1)] The article of manufacture as claimed in Claim 2, characterized in that the spinel is present as a mixture in the ternary system of the type AB_2X_4-AX-B_2X_3.

6. (Twice Amended) [Product (1)] The article of manufacture as claimed in Claim 2, characterized in that the mixed oxide system with the spinel has an additional oxide or several additional oxides admixed to the spinel.

7. (Twice Amended) [Product (1)] The article of manufacture as claimed in Claim 6, characterized in that the additional oxide is stabilized with yttrium oxide (Y_2O_3) or another rare earth oxide.

9. (Twice Amended) [Product (1)] The article of manufacture as claimed in Claim 2, characterized in that between [basic] the base body [(2)] and the thermal barrier coating [(4)] a bond coat [(3)] forming a bonding oxide is disposed.

10. (Amended) [Product (1)] The article of manufacture as claimed in Claim 9, characterized in that the bond coat (3) is any alloy comprising at least one of the elements of the spinel.

11. (Twice Amended) [Product (1)] The article of manufacture as claimed in Claim 2, characterized in that [it] the article is designed as a component of a thermal turbo machine, particularly a gas turbine.

12. (Amended) [Product (1)] The article of manufacture as claimed in Claim 10, characterized in that [it] the article is designed as a turbine moving blade, a turbine stationary blade or a heat shield of a combustion chamber.

13. (Twice Amended) [Product (1)] The article of manufacture as claimed in Claim 2, characterized in that the thermal expansion coefficient α of the spinel is between $6*10^{-6}$/K and $17*10^{-6}$/K.

14. (Twice Amended) [Product (1)] The article of manufacture as claimed in Claim 2, characterized in that the thermal conductivity of the spinel is between 1.0 W/mK and 4.0 W/mK.

15. (Twice Amended) [Product (1)] The article of manufacture as claimed in Claim 2, wherein the metallic base body [(4)] has a superalloy comprising nickel, cobalt and/or chromium[-based super alloy].

16. (Amended) [Process for producing] A method of manufacturing a thermal barrier coating on a gas turbine component with a metallic base body, wherein a pre-reacted spinel of the structural formula AB_2X_4 excluding the spinels of the structural formula $FeCr_2O_4$, $FeAl_2O_4$, $FeFe_2O_4$, $NiAl_2O_4$ and $NiCr_2O_4$ is applied by means of plasma spraying or vapor deposition.

17. (Amended) [Product (1)] The article of manufacture as claimed in Claim 1, characterized in that the spinel is present as a mixture in the ternary system of the type AB_2X_4-AX-B_2X_3.

18. (Amended) [Product (1)] The article of manufacture as claimed in Claim 1, characterized in that the mixed oxide system with the spinel has an additional oxide or several additional oxides admixed to the spinel.

19. (Amended) [Product (1)] The article of manufacture as claimed in Claim 1, characterized in that between basic body [(2)] and thermal barrier coating [(4)] a bond coat [(3)] forming a bonding oxide is disposed.

20. (Twice Amended) [Product (1)] The article of manufacture as claimed in Claim 2, characterized in that the thermal expansion coefficient α of the spinel is between $6*10^{-6}$/K and $17*10^{-6}$/K.

21. (Twice Amended) [Product (1)] The article of manufacture as claimed in Claim 2, characterized in that the thermal conductivity of the spinel is between 1.0 W/mK and 4.0 W/mK.

22. (Twice Amended) [Product (1)] The article of manufacture as claimed in Claim 2, wherein the metallic base body [(4)] has a superalloy comprising nickel, cobalt and/or chromium[-based super alloy].